

## **SCDHEC *Earth Today***

**Lesson Grade Level: 7**

**Lesson Title:** Power Crisis in Energy-ville!

**SC State Science Standard(s):**

(III, A, 7, e) Distinguish between renewable and nonrenewable resources and examine the importance of their conservation. **(P)**

**Segment Link:**

Late in the first part of the video when they are talking about the benefits of conserving energy and late in the second part of the video when they are talking about the importance of reducing mining and drilling.

**Lesson Overview:**

This lesson further develops the ideas presented in the video about the importance of conserving energy as a way to reduce our dependency on foreign oil and non-renewable resources provided by mining and drilling. It is set up as a collaborative learning effort in which the students work in groups to solve a problem about energy management for a fictional community. This activity will require that the teacher cover the different sources of both renewable and non-renewable resources used in the activity.

**Background:**

Non-renewable resources are those materials that are either mined, drilled or pumped from underground that, once extracted, cannot be replaced or renewed. For example, fossil fuels take millions of years for the Earth to produce yet are being extracted and consumed in a tiny fraction of the time needed to create them. Mineral resources such as tin, iron, copper and uranium are rare metals that are mined from locations where they are in abundance. Once the location is depleted, a new source must be found. In both cases, the Earth only has a limited amount of these resources and once they have been depleted, there will be no more. Furthermore, both the extraction and use of most of these resources produce additional pollution in the environment. And often these resources can only be found in abundance in other countries. Renewable resources are things such as hydroelectric power, geothermal power, solar power, biomass and wind power, sources of energy that do not depend on limited resources taken from the Earth. In every case except solar power, these sources of energy result from turbines spinning to produce electricity. Hydroelectric power uses running water passing through a dam. Wind power uses windmills in places where strong winds are common. Geothermal power uses heat from underground (magma) to heat water to produce steam, which is pumped over the turbine to get it to spin. Solar power uses solar panels to collect the sun's energy and convert it into electrical energy. Biofuels such as methane, ethanol and methanol, release the potential energy stored in the organic biomass that is generated through photosynthesis. While all of these sources are both renewable and non-polluting, they are often expensive and produce less energy than conventional fossil fuel burning or nuclear power plants.

**Lesson Plan:**

1. Organize students into collaborative learning groups.
2. Each group is given a copy of the attached worksheet and will need to figure out what will be the best way to provide power for their community while at the same time addressing the concerns about pollution.

**Additional Teacher Background:**

South Carolina imports 98 percent of its energy resources. We don't produce any coal, oil or natural gas. Because we have none of our own energy resources to speak of, we must rely on other states and other countries to supply us with this necessity. In these times of worldwide political upheaval, it is more important than ever that we reduce our dependency on foreign energy sources.

South Carolina is a growing state where energy plays a big role in its economic success. As our economy has grown over the years from creating new jobs and industries, so too have our energy needs. South Carolina ranks 18<sup>th</sup> in the nation in total energy use per capita, using more energy per person than 32 states. We spend more than \$8 billion per year on energy alone. Most of this energy is in the form of fossil fuels such as coal, petroleum and natural gas, fuels that will eventually run out. Because we import 98 percent of our energy sources, this makes us vulnerable to shortages imposed by Middle Eastern countries that are "oil rich". Bad relations with these countries could not only bring about oil import shortage, but also the possibilities of attacks on power plants, storage facilities and pipelines. We must act now to use our plentiful renewable energy sources such as solar, wood waste, farm products and garbage to meet our everyday energy needs. We all need to be more efficient and not waste energy.

Emissions from fossil fuel power plants are caused when we use non-renewable fossil fuels (petroleum, natural gas and coal) to produce energy. As we increase our energy use, we have to build more power plants. We want to stress the importance of using renewable energy sources (solar, geothermal, hydro, biomass, wind), as these are clean and unlimited.

A variety of gases and particulates are formed when fossil fuels are burned in the production of electricity. Among the gases emitted during such burning are sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NOX) and carbon dioxide (CO<sub>2</sub>). If these gases are not captured by some type of pollution control equipment, they are released into the atmosphere. Estimated emissions from all fossil-fueled steam-electric generating units at South Carolina electric utilities increased by 34% from 1993 to 1999, and by 8.7% from 1998 to 1999. In 1999, carbon dioxide from coal-fired plants accounted for 97% of emissions from fossil-fueled generating units in South Carolina. Consequently, the pollution control equipment used most often at the generation units in the electric utility plants in South Carolina is particulate collection, which is mainly centered on coal combustion because of the large percentage of ash that coal contains. This particulate matter from coal is most frequently removed from the combustion gases by either filtering in a baghouse, or in an electrostatic precipitator. In this case the particulates are given an electric charge and collected.

## **Power Crisis in the Town of Energy-ville**

You are on Energy-ville's town council. Energy-ville gets its power right now from coal that it imports from the neighboring county of Greed-land. This county has just told your town that they are raising the cost of the coal. The town wants you to figure out how to lower the cost of electricity while at the same time protecting the environment. You must balance the need of less expensive power with the possible harm to the environment from pollution and mining. And you must sell your idea to the people in your town.

### **Resources in the area around Energy-ville:**

The river running through the town  
Hot springs up in the hills away from the town  
A narrow valley with strong winds  
Natural gas may be available  
A large chicken farm

### **Location Problems:**

Building a dam on the river would flood the valley upstream where people live.  
The hot springs are in the hills not close to Energy-ville.  
The narrow valley is not very large and the winds are not constant.  
The natural gas is located under a farmer's field.  
There are few large areas for solar panels.

### **Costs:**

Importing coal from Greed-land: \$3 million each year  
Build a dam: \$5 million one time only + ½ million each year  
Build windmills: \$3 million one time only + ½ million each year  
Build geothermal plant: \$4 million one time only + ½ million each year  
Set up solar panels: \$2 million one time only + ½ million each year  
Drill for natural gas: \$3 million one time only + ½ million each year  
Build a biomass-burning digester vessel: \$2 million one time only + ½ million each year

### **Energy produced and pollution created:**

Imported Coal: 100 percent of the town's needs / smoke clouds, acid rain, "greenhouse gases"  
Hydroelectric: 75 percent of the town's needs / silt filling up the lake behind the dam  
Wind Power: 20 percent of the town's needs / none  
Geothermal: 40 percent of the town's needs / none  
Solar Power: 10 percent of the town's needs / none  
Natural Gas: 100 percent of the town's needs / acid rain, "greenhouse gases"  
Biomass Fuels: 30 percent of the town's needs / "greenhouse gases"

### **Questions:**

1. Which source or sources of energy did your group choose and why?
2. What problems did you have in making your choice?
3. How will you convince the town to follow your plan?